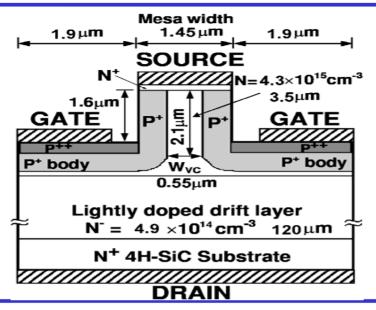


## Development of Critical 4H-SiC Processes for Demonstrating A Novel SiC Power Switch Capable of 10kV-100A SiCLAB, Rutgers University, Piscataway, NJ 08854



## **Key Accomplishments**

- 1. Processing technologies developed for very high voltage normally-off SiC power VJFET fabrication.
- 2. MJTE edge termination technology developed for over 10kV SiC diodes and switches.
- 3. Implant conditions optimized and lateral channel mobility of  $\sim$ 400cm<sup>2</sup>/Vs achieved.
- 4. 800V-1.2kV and 3 kV normally-off VJFETs fabricated and achieved world record performances.
- 3. Fabricated and published the world's first 10 kV-1A SiC Schottky diode with  $R_{\text{SP ON}}$  =97m $\Omega \text{cm}^2.$
- 4. Fabricated and published the world's first 11 kV SiC VJFET (normally-off) with  $R_{SP\_ON}$ =131m $\Omega$ cm<sup>2</sup> with low leakage current density of 1mA/cm<sup>2</sup> at 11kV.
- 5. 10kV SiC normally-off VJFETs achieved 0.05mA/cm<sup>2</sup> leakage current density at 10kV, exceeding program target of 1mA/cm<sup>2</sup> at 10kV.

## **Goals, Objectives and Main Technical Approach**

- Developing critical SiC processing technologies and optimum designs for the fabrication of oxide-free 4H-SiC power switches based on VJFETs targeting up to 10 kV in Phase I and 10 kV-100A in Phase II.
- 2. Optimizing implant conditions to maximize channel mobility;
- 3. Fabricating and evaluating lateral JFETs suitable for correlating processing conditions and channel mobility;
- 4. Developing and improving multi-MeV ion implantation technology for scaling up blocking voltage of VJFETs;
- 5. Optimizing 4H-SiC VJFET design through computer modeling;
- 6. Integrating advanced processing technologies to demonstrate 4H-SiC VJFETs targeting 800V-1,200V, 3kV and 10kV.

## **Major Impact of Technology & Technology Transition Plan**

- 1. Providing an alternate to MOSFET-based unipolar power switch for high-temperature applications;
- 2. Providing multi-MeV ion implant technology suitable for scaling up the power rating of the VJFET;
- 3. Providing process technology for maximizing channel mobility;
- 4. Providing a process recipe for scaling normally-off VJFET to large area with high current;
- 5. Industry collaborator is now further improving the technologies for commercialization of SiC VJFETs

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